education

Department:
Education
PROVINCE OF KWAZULU-NATAL

PHYSICAL SCIENCES P2 (CHEMISTRY)

PREPARATORY EXAMINATION

SEPTEMBER 2019

MEMORANDUM

NATIONAL SENIOR CERTIFICATE

GRADE 12

MARKS : 150

This marking guideline consists of 8 pages.

QUESTION 1

1.1 D ✓✓ (2)

1.2 C✓✓ (2)

1.3 A✓✓ (2)

1.4 C✓✓ (2)

1.5 D✓✓ (2)

1.6 D✓✓ (2)

1.7 D✓✓ (2)

1.8 C✓✓ (2)

1.9 C✓✓ (2)

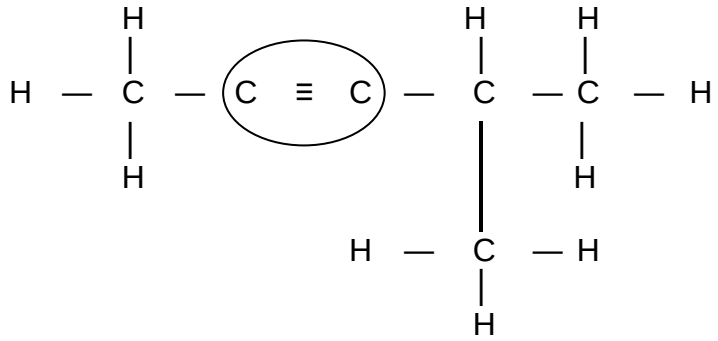
1.10 B✓✓ (2)
[20]

QUESTION 2

2.1.1 hexan-3-one ✓✓ (2)

2.1.2 carboxyl (group) ✓ (1)

2.1.3

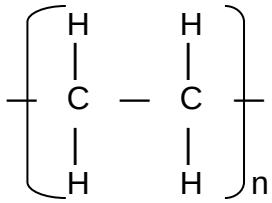


- Whole structure correct: 2/2
- Only functional group correct 1/2
- More than one functional group 0/2

(2)

2.1.4 addition polymerisation✓ (1)

2.1.5



- Whole structure correct ✓✓
- Name ✓

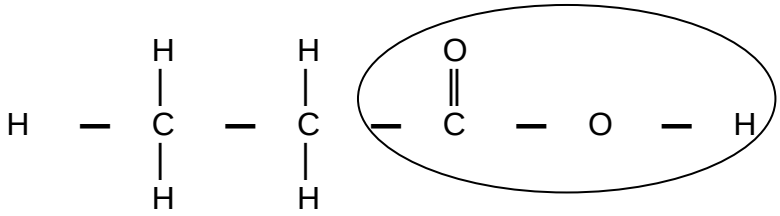
polyethene✓ (3)

2.1.6 G✓ (1)

2.2.1 esters/alkyl alkanoate✓ (1)

2.2.2 ethyl✓ propanoate✓ (2)

2.2.3



- Whole structure correct: 2/2
- Only functional group correct 1/2
- More than one functional group 0/2

(2)

2.2.4 acts as a catalyst/speeds up the reaction. ✓ or
acts as a dehydrating agent. ✓ (1)

2.3.1 Compounds that have the same molecular formula but different functional groups✓✓ (2)

2.3.2 pentanoic acid✓ (2)
[20]

QUESTION 3

3.1 the pressure exerted by a vapour at equilibrium with its liquid in a closed system. ✓✓ (2 or 0) (2)

3.2.1 length of carbon chain/surface area/branching✓ (1)

3.2.2 number of carbon atoms/molecular mass✓ (1)

3.3.1 GREATER THAN✓ (1)

3.3.2 M has a longer carbon chain/greater surface area than N/ M has more sites for intermolecular forces✓
Intermolecular forces between molecules of M are stronger than between molecules of N✓
More energy is required to overcome the intermolecular forces between molecules of M✓ (3)

3.4 N✓ (1)
[9]

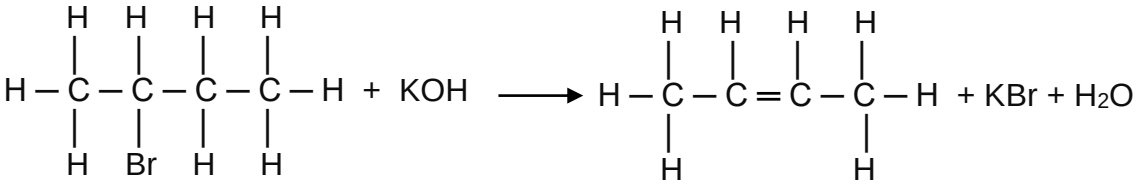
QUESTION 4

4.1.1 warm/mild heat✓ dilute KOH✓/warm✓ dilute strong base✓ (2)

4.1.2 hot KOH✓ concentrated ✓Base(KOH) (2)

4.2 substitution✓ (1)

4.3



- ✓ left hand side
- ✓✓ for organic product
- ✓ balancing

(4)

4.4 unsaturated✓
contains a double bond/multiple bond✓ between atoms of carbon✓ (3)

4.5 hydration✓✓ (2)

[14]

QUESTION 5

5.1 calcium carbonate✓ there is some unreacted $CaCO_3$ at the end of the reaction (time 60s) ✓ (2)

5.2.1 **ANY ONE**

- The change in concentration✓ of reactants/products per unit time. ✓
- Rate of change in concentration of reactants or products. ✓✓
- Change in amount/number of moles/volume/mass of reactants/products per (unit) time.
- Amount/number of moles/volume/mass of products formed OR reactants used per (unit) time. (2)

5.2.2 $\text{rate} = -\frac{\text{change in mass of } CaCO_3}{\Delta t}$ ✓

$1{,}07 \overset{\checkmark}{=} -\frac{54 - X}{30 - 0}$ ✓

$= 86{,}10 \text{ g}$ ✓

(if answer is negative minus 1 mark) (5)

Marking criteria

- Equation✓(accept if negative sign is omitted)
- Substitute 54 – X in equation ✓
- Substitute 30 – 0 in equation✓
- Substitute 1,07✓for rate
- Final answer: X = 86,10 g ✓

5.3 0 (cm^3). ✓ (1)

5.4 A decrease in concentration of reactants decreases the number of molecules per unit volume. ✓
Fewer number of collisions per unit time✓
A fewer number of effective collisions occur per unit time/lower frequency of effective collisions. ✓ (3)

5.5 REMAINS THE SAME✓ (1)
[14]

QUESTION 6

6.1 When the equilibrium in a closed system is disturbed, the system will re-instate a new equilibrium by favouring the reaction that will oppose the disturbance. ✓✓ (2 or 0) (2)

6.2 the reaction has reached a state of (dynamic) equilibrium/the rate of the forward reaction is equal to the rate of the reverse reaction. ✓✓(2 or 0) (2)

6.3

Marking criteria:
- Indicating that the number of mols of CO equilibrium is 0,6✓
- Correct mol ratio✓
- Calculating the quantity(mol) at equilibrium of all three substances ✓
- Substitute V = 2 dm^3 in $c = \frac{n}{V}$ to determine concentration at equilibrium of all the substances.✓
- K_c expression✓
- Substitution of concentrations in K_c expression ✓
- Final answer: 0,456 ✓

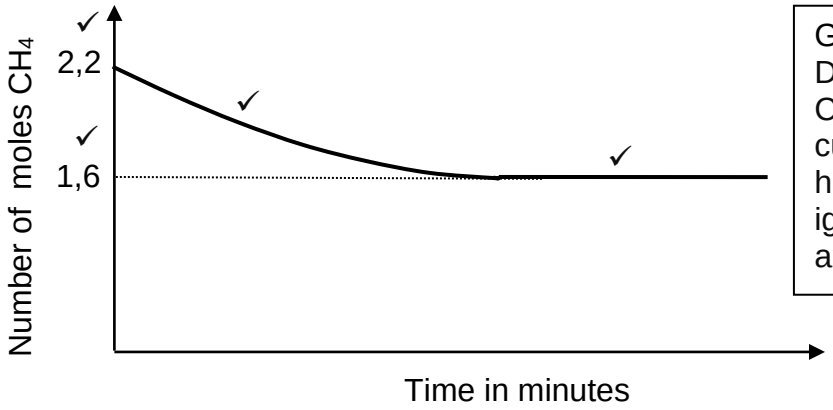
No K_c expression, correct substitution: Max. $\frac{6}{7}$

Wrong K_c expression : Max. $\frac{4}{7}$

	CH_4	H_2O	CO	H_2	
Initial quantity(mol)	2,2	1,8	0	0	
Change(mol)	-0,6	-0,6	+0,6	+ 1,8	Ratio ✓
Quantity at equilibrium(mol)	1,6	1,2	0,6✓	1,8 ✓	
Equilibrium concentration($mol.dm^{-3}$)	0,8	0,6	0,3	0,9	Divide by 2✓

$$K_c = \frac{[CO]\,[H_2]^3}{[CH_4]\,[H_2O]} \checkmark = \frac{(0,3)\,(0,9)^3}{(0,8)\,(0,6)} \checkmark = 0,456 \checkmark \quad (7)$$

6.4



Graph starts at 2,2✓
Decreases to 1,6✓
Correct shape curve✓
horizontal✓
ignore labels on axes

(4)

6.5.1 INCREASES✓ (1)

6.5.2 REMAINS THE SAME✓ (1)

6.6 An increase in the number of moles of CH_4 increases the concentration of CH_4(reactant).
According to Le Chateliers Principle an <u>increase in the concentration of the reactants</u> ✓ <u>favours the reaction that decreases the concentration of the reactants</u>✓
In this case the <u>forward reaction is favoured</u>✓

(3)
[20]

QUESTION 7

7.1.1 An acid is a substance that produces hydrogen ions(H^+)/hydronium ions(H_3O^+)✓ when it dissolves in water. ✓ (2)

7.1.2 strong✓
it ionises completely in water✓ ✓ (ACCEPT: dissociates) (3)

7.2.1

$pH = - \log [H_3O^+]$ ✓

0,65✓ $= - \log [H_3O^+]$

$\therefore [H_3O^+] = 0,224$ mol.dm^{-3}

$c((H_2SO_4) = \frac{1}{2}c(H_3O^+)$ ✓
$= \frac{1}{2}(0,224)$
$= 0,112$ mol.dm^{-3}✓

- Formula pH = - log $[H_3O^+]$ ✓
- Substitute 0,65 for pH✓
- $c((H_2SO_4) = \frac{1}{2}c(H_3O^+)$✓
- $c((H_2SO_4) = 0,112$ mol.dm^{-3}✓

(4)

7.2.2 POSITIVE MARKING FROM QUESTION 7.2.1: concentration of H_2SO_4

Marking guidelines/*Nasienriglyne:*

- Formulae: $c = \frac{n}{V}$ /n = cV/ ✓
- Calculate initial number of moles of H_2SO_4✓
- Calculate number of moles of H_2SO_4 that reacted✓
- Calculate number of moles of H_2SO_4 in excess✓
- Calculate number of moles of NaOH that reacted✓
- Ratio of NaOH to H_2SO_4✓
- Final answer cm^3 or dm^3✓

$n(H_2SO_4)initial = cV$✓
$= (0,25)(0,024)$ ✓
$= 6 \times 10^{-3}$ mols

$n(H_2SO_4)excess = cV$
$= (0,112)\frac{(X + 24)}{1000}$ ✓

$n(H_2SO_4)reacted = 6 \times 10^{-3} - \frac{(0,112)(X + 24)}{1000}$ ✓

$n(NaOH)reacted = cV$
$\frac{0,15(X)}{1000}$ ✓

$n(NaOH)reacted = 2\ (n(H_2SO_4)reacted)$✓

$\frac{0,15(X)}{1000} = 2\left(6 \times 10^{-3} - \frac{(0,112)(X + 24)}{1000}\right)$
$X = 17,71\ cm^3$✓ $0,01771\ dm^3$

(7)
[16]

QUESTION 8

8.1 a solution/liquid/dissolved substance✓ that conducts electricity through the movement of ions.✓ (2)

8.2 $\underline{Zn(s) \rightarrow Zn^{2+}(aq) + 2e^-}$

Notes

- $Zn^{2+} + 2e^- \leftarrow Zn$ $(2/2)$ $Zn^{2+} + 2e^- \rightleftharpoons Zn$ $(0/2)$
  $Zn \rightleftharpoons Zn^{2+} + 2e^-$ $(1/2)$ $Zn^{2+} + 2e \rightarrow Zn$ $(0/2)$
- Ignore if charge on electron is omitted.
- If a charge of an ion is omitted e.g. $Zn \rightarrow Zn^2 + 2e^-$ Max.: $1/2$

(2)

8.3.1 Temperature of 25 ºC/298K✓
Concentration of the electrolytes equals 1 $mol.dm^{-3}$. ✓ (2)

8.3.2 $E^{\Theta}_{cell} = E^{\Theta}_{cathode} - E^{\Theta}_{anode}$ ✓
0,63✓ $= E^{\Theta}_{cathode} - (-0,76)$ ✓
$E^{\Theta}_{cathode} = -0,13$ V ✓
X is lead(Pb) ✓

Notes
- Accept any other correct formula from the data sheet.
- Any other formula using unconventional abbreviations, e.g. $E°_{cell} = E°_{OA} - E°_{RA}$ followed by correct substitutions:
  $E°_{sel} = E°_{OM} - E°_{RM}$ *Max/:* $^{4}/_{5}$

(5)

8.4 $Zn(s)/Zn^{2+}(aq)$ ✓//✓$Pb^{2+}(aq)/Pb(s)$ ✓
$Zn(s)/Zn^{2+}(1\ mol.dm^{-3})$ ✓//✓$Pb^{2+}(1\ mol.dm^{-3})/Pb(s)$
Accept $Zn/Zn^{2+}//Pb^{2+}/Pb$ (3)

8.5 0(V) ✓ (1)

[15]

QUESTION 9

9.1 from electrical energy to chemical energy✓ (1)

9.2 P✓ (1)

9.3 $Cu^{2+} + 2e^{-} \rightarrow Cu$

Notes
- $Cu^{2+} + 2e^{-} \leftarrow Cu$ ($^{0}/_{2}$) $Cu^{2+} + 2e^{-} \rightleftharpoons Cu$ ($^{1}/_{2}$)
  $Cu \rightleftharpoons Cu^{2+} + 2e^{-}$ ($^{0}/_{2}$) $Cu^{2+} + 2e \rightarrow Cu$ ($^{2}/_{2}$)
- Ignore if charge on electron is omitted.
- If a charge of an ion is omitted e.g. $Cu \rightarrow Cu^{2} + 2e^{-}$ Max.: $^{1}/_{2}$

(2)

9.4.1 Q will break down/become eroded/surface becomes rough and eroded✓✓
ACCEPT Q will be oxidised. ✓✓ (2)

9.4.2 Cu/electrode Q is a stronger reducing agent✓ than the $C\ell^{-}$ ions✓.
Cu/Q will be oxidised/loses electrons✓ resulting in the electrode becoming eroded
OR
The $C\ell^{-}$ ion is a weaker reducing agent✓ than Cu(Q) ✓and will therefore not be oxidised. ✓ (3)

9.4.3 P✓ (1)

[10]

QUESTION 10

10.1.1 Haber process✓ (1)
10.1.2 nitric oxide✓ NO✓ (1)
10.1.3 platinum✓ (1)
10.1.4 $HNO_3 + NH_3 \rightarrow (NH_4)NO_3$ (3)

Notes:
- Reactants ✓ Products ✓ Balancing ✓
- Ignore double arrows.
- Marking rule 6.3.10.

10.2
Mass P = 31✓/149✓ x11,95✓ = 2,486 kg
2/8 x Z/100 x 20✓ = 2,486✓
Z = 49,72%✓

(6)

TOTAL MARKS: 150